Green Roofs

In a Nutshell

A green roof is a roof of a building that is partially or completely covered with vegetation growth. Green roofs absorb rainwater, provide insulation, provide a living space for insects and birds, and help to mitigate the heat island effect. In addition, green roofs reduce energy costs and can enhance the quality of life for residents nearby.

The “How To”

Summary of Green Roofs

The term Green Roof typically refers to any building whose roof is covered or partially covered with vegetation. Usually the vegetation is planted and almost appears to be a lawn on top of a building. Green roofs, however, can also refer to buildings that have potted plants on their roofs or can even refer to buildings that have used green building technologies, such as solar thermal collectors, in their development. Green roofs are becoming increasingly popular in big cities as they attempt to mitigate the heat island effect.



Types of Green Roof Systems

There are two types of green roof systems: extensive and intensive. There is also some mention of a partial-intensive system, which falls between extensive and intensive on the scale of size and necessary maintenance. The main differences arise from design criteria and types of plants selected. Some features of each are listed below.

Extensive

- Also known as low-profile
- Typically contains one or two types of plants and minimal planting medium
- Commonly designed for maximum thermal and hydrological performance with minimal weight load
- Typically only maintenance personnel have access
- Installed on flat and pitched roofs

Intensive

- Also known as high-profile
- Typically contains a variety of plant species and is designed as a park-like setting
- Some have fairly large trees and water features
- Typically allow public access

Components and Installation of Green Roofs

Regardless of the type, all green roof systems have the same broad components, listed below. Typically construction or landscape architects will design the green roof systems, and although they might be different from other examples, the basic components should be present. The International Green Roof Association offers a checklist for planning your green roof that includes construction/engineering and vegetation considerations.

From the top layer down:

- Vegetation
- Lightweight, engineered growing medium
- Filter membrane
- Drainage layer
- Root barrier
- Waterproofing/roofing membrane
- Cover board
- Thermal insulation
- Vapor barrier
- Building and roof structural support

Green roofs can be installed in several ways. They can be installed in an interlocking grid system with the soil, drainage parts, filter cloth, and plants already prepared within them. Building the green roof in this manner allows each component to be installed separately. One large plot can also be used as the planting area, in which only one container is used to hold all of the components of the green roof. Plant selection depends on a variety of factors, including climate, composition and depth of growing medium, loading capacity of the roof, height and slope of the roof, maintenance expectations, and the presence or absence of a functioning irrigation system.

Operation and Maintenance of Green Roofs

Green roofs should be allowed to grow and mature. Regardless of which type your green roof is, it will need time in order for the plants and grasses to grow. Green roofs work best when the vegetation is growing and becomes established. There are different maintenance demands, depending on the green roof type.

Intensive green roofs, which tend to be more like a park setting, require much more maintenance than extensive. It is helpful to view intensive green roofs as parkland and treat it the same way you treat your parks.

Weeding, irrigating, fertilizing, removing trash, and other garden practices are usually necessary.

Extensive green roofs tend to require less maintenance. Less maintenance does not mean no maintenance, and consideration should still be given to watering, fertilizing, and removing any trash or debris from the roof.

Planning & Zoning

Regulation Considerations

There are not many ordinances or regulations regarding the use of green roofs yet. It is important that you check with your local municipality before building a green roof to ensure that you are adhering to what is allowable in your community.

Green roofs are heavy. Your green roof will add substantial weight to the structure of your building, and necessary steps and precautions must be followed. Attaining the proper permitting and plans must happen before construction of any kind can occur within a municipality, and green roofs are no exception. Engineers and architects are able to perform a structural analysis on your existing roof, design necessary modifications, and help with the planning and permitting process.



Municipal Incentives

Some municipalities and organizations offer incentives to homeowners who install a green roof system on their building roofs. The Metropolitan St. Louis Sewer District is currently offering rainscaping grants for qualifying homeowners, which can be used for a green roof, among other projects.

Dollars & Cents

Costs of Building a Green Roof

According to the Environmental Protection Agency, prices for installing a green roof start around $10 per square foot for simpler extensive systems and can reach $25 per square foot for more complex intensive

systems.

Maintenance Costs of a Green Roof

Also according to the EPA, annual maintenance costs can range from roughly $0.75 to $1.50 per square foot for either type of system. As the plants establish and mature, most of the maintenance costs will arise during the first year after they have been planted. Maintenance costs for extensive roofs will decline as the plants grow and cover the entire roof, but the maintenance costs of intensive roofs tend to remain more constant due to the increased complexity of the system.

Ways to Save Money

While the initial costs of green roofs are higher than those of conventional materials, building owners can help offset the difference through reduced energy and stormwater management costs, and potentially by the longer lifespan of green roofs compared with conventional roofing materials. Green roofs, if built correctly, will outlive a standard roof. If combined with other stormwater harvesting techniques, the cost of watering the green roof can be minimized.

Measuring Success

Homeowner Measurables

In comparison to other sustainable development ideas, green roofs are on the expensive side of the spectrum. However, the cost savings that green roofs offer make up for the implementation cost. In order for a homeowner to measure the savings, all that would be needed are the heating and cooling bills from before and after implementation. In the summer, the green roof keeps the building beneath it cool; in the winter, the green roof acts as additional insulation keeping the building warm.

Additionally, if you choose to grow vegetables in your roof-top garden, you can potentially experience cost savings when shopping for groceries.

Policy Success

Green roofs are still a relatively young sustainability option in the United States, but the practice of creating them has begun to gain traction. With cities like Chicago and companies like the Ford Motor Company implementing green roofs in large capacities, the practice is becoming more common. The best way to create more green roofs is to continue advocating and educating residents and business owners about their effectiveness.

Municipalities and counties can create legislation advocating for their creation or can avoid making legislation that will hinder the development of green roofs. Cities and counties can provide financial incentives like those listed in the Planning & Zoning tab. Residents are more likely to give green roofs a realistic consideration if they know the city government is supporting the decision.

American Society of Landscape Architects

In May of 2006, the American Society of Landscape Architects (ASLA) installed a 3,000 square foot green roof installed on the roof of their headwuarters in Washington, DC. ETEC, LLC, an environmental consulting firm, studied the green roof over the fall of 2006 and spring of 2007. Highlighted results of the study are listed below.

- Green roof produced 10 percent decrease in building energy use over the winter months
- Temperature on green roof can be as much as 59 degrees cooler, during the hottest summer months, than conventional roofs on neighboring buildings
- Over a ten month period, the green roof prevented 27,500 gallons of stormwater from flowing into the stormwater and sewer system
- With the exception of repeated heavy rains, the green roof only creates runoff during downfalls of more than one inch

Discover More

Green Roofs for Healthy Cities advocates for the implementation of green roofs and provides information regarding recent legislation.

The Housing and Economic Development Department of the City of Chicago has established a green roof dataset and map that provides the location, satellite images, and square footage of existing green roofs within the City of Chicago. At the time of the initial study, there were 359 green roofs totalling almost 5.5 million square feet in total size.

Washington University in St. Louis recently installed a green roof on campus that appears to be a simple extension of the lawn.

Case Studies

Centene Plaza

Contact

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Cost

Installation Cost

Green Roof System - $404,255

Annual Operation, Projected Maintenance Cost, Activities and Frequency

Operation and maintenance activities required throughout the year include the following:

- Watering of plants when rainfall drought exceeds three to four weeks. ¾ inch rain every 4 weeks is required for vegetation to be sustained.
- Removal of errant weeds as necessary, typically twice annually.
- Providing slow release fertilizer, such as Woodace's 18-5-10 Longterm at a rate of 50lbs/ 9000 square feet (delivering 0.5 lbs of Nitrogen) once a year in the spring for the first five years. Beyond the initial five years, monitoring of the nutrient level of the engineered soil and supplement may be needed. Typically, no additional feeding is required beyond the initial five years.
- Monitoring plants for bird and pest damage and address using natural control methods when possible. Caution should be taken when using chemical or natural remedies that may adversely affect surrounding environments.
- Monitoring roof drainage systems for possible obstruction from plants or engineered soil. The drainage systems and roof access should be kept free from plant overgrowth.

Lessons Learned

The most memorable part of the installation was getting the material in place and getting the plants established. The greatest challenge during the installation of the system was construction sequencing with the building construction activities. Construction sequencing proved to be critical to timely and costly completion of the installation. Some sections of the system were planted twice as result of equipment and installation sequencing. In these cases, the green roof system went in before some of the glazing was completed as a result some of the young plants died.

As of June 2012, the vegetation is looking good and is established. The main concern is if rain doesn't come as needed, ¾ of an inch of rain every 4 weeks, the irrigation system will be used. The irrigation system used water from the buildings water supply, it is a temporary system used for plant establishment and supplemental watering in the cases of rain water not coming as needed.